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(FILE 'HOME' ENTERED AT 13:03:58 ON 22 NOV 1999)

FILE 'HCA' ENTERED AT 13:04:05 ON 22 NOV 1999

L1	724	SOLDER? AND INTERMETALLIC?
L2	504	L1 AND (TIN OR SN)
L3	104	L2 AND (COPPER OR CU) AND (SILVER OR AG)
L4	33	L2 AND COMPOSITE?
L5	20	L4 NOT L3
		E BIELER THOMAS/IN
		E BIELER THOMAS/AU
L6	206	E2-E5
		E BRIGHTON SUBRAMANIAN/AU
		E BRIGHTON SUBRAMANIAN/IN
		E CHOI SUNGLAK/IN
		E CHOI SUNGLAK/AU
		E CHOI SUNG/IN
L7	4	L6 AND L1

AN 129:345955 HCA
TI Nanoindentation characterization of microphases in Sn-3.5Ag eutectic **solder** joints
AU Lucas, J. P.; Gibson, A. W.; Subramanian, K. N.; **Bieler, T. R.**
CS Michigan State University, East Lansing, MI, 48823, USA
SO Mater. Res. Soc. Symp. Proc. (1998), 522(Fundamentals of Nanoindentation and Nanotribology), 339-345
CODEN: MRSPDH; ISSN: 0272-9172
PB Materials Research Society
DT Journal
LA English
AB Nanoindentation testing was used to obtain mech. properties on realistic Sn-Ag **solder** joints made with (1) eutectic Sn-3.5Ag **solder** (2) in-situ Cu6Sn5 particle reinforced eutectic Sn-Ag matrix composite **solder**. The composite **solder** joint contained .apprx.20 vol.% added Cu6Sn5 **intermetallic** particles .apprx.5 .mu. diam. The particles were dispersed in-situ in the eutectic Sn-3.5Ag matrix alloy as a reinforcement phase to stabilize the microstructure by acting as a non-coarsening microconstituent phase. Mech. property characterization and deformation behavior were assessed for the bulk microstructure and on microconstituents in the actual **solder** joints. Mech. property data obtained on constituents included hardness, elastic modulus, strain rate, and creep behavior. The pushing and rotation of the reinforcement particles that often occurred when contacted by the indenter provided a means for evaluating the interfacial shear strength of reinforcement particles in the **solder** matrix.

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AN 131:302123 HCA
TI The growth prevention of **intermetallic** compounds at the joint interface in lead-free **solder**
AU Kayatani, Takayuki; Takaoka, Hidekiyo; Hamada, Kunihiko; Tokuda, Yu; Sakabe, Yukio
CS R&D Divition, Group II, Materials Development Department, MURATA, MFG CO;Ltd, oshinohara, yasu-cho, shiga, 520-2393, Japan
SO Symp. "Microjoining Assem. Technol. Electron." (1999), 5th, 433-438 CODEN: SMAEFT
PB Yosetsu Gakkai
DT Journal
LA Japanese
AB The growth of **intermetallics** at the **solder**/substrate interface and electrode leaching are the main factors affecting the reliability of the **solder** joints for electronic components. We investigated the growth of **intermetallics** during aging formed at **solder**/**Ag** and **Cu** substrate in Pb-free **solders**, **Sn**-3.5Ag and the effect of the Ni, Zn addn. to prevent the growth. After aging, Ag3Sn and CuSn **intermetallics** thicknesses were very thin in the **Sn**-3.5Ag compared with **Sn**-40Pb. Both the case of **Ag** and **Cu** substrate, added Zn in the **solder** concd. at **Ag**/Ag3Sn, **Cu**/Cu3Sn interface during aging, resp. After 150.degree.C for 960 h, addn. of Zn to **Sn**-3.5Ag suppressed the growth of Ag3Sn and CuSn **intermetallics**. On the other hand, added Ni in the **solder** concd. only in **Cu** substrate. Ni concd. layer was formed at the Cu6Sn5/**solder** interface without aging. The d. of metal additives such as Ni or Zn suppressed the growth of **intermetallics** at the **solder**/substrate interface regardless of position of concd. layer.

AN 130:69829 HCA
TI Comparison of mechanical fatigue fracture behavior of eutectic Sn-Ag **solder** with and without Cu6Sn5 **intermetallic** particulate reinforcement
AU Gibson, A. W.; Subramanian, K. N.; **Bieler, T. R.**
CS Materials Science and Mechanics, Michigan State University, MI, USA
SO J. Adv. Mater. (1998), 30(2), 19-24
CODEN: JADMEK; ISSN: 1070-9789
PB Society for the Advancement of Material and Process Engineering
DT Journal
LA English
AB The isothermal mech. fatigue fracture behavior of noncomposite eutectic Sn-Ag and composite eutectic Sn-Ag **solder** contg. 20 vol.% Cu6Sn5 is examd. Single shear lap joints of both **solders** were fabricated using copper substrates and subjected to isothermal mech., cantilever bending fatigue at a frequency of 50 Hz. The fracture surfaces of noncomposite eutectic Sn-Ag **solder** joints exhibited ductile, mixed mode (I and II) fracture behavior and step-type fatigue striations that originated at a local region. The fracture surfaces of the composite eutectic Sn-Ag **solder** contg. 20 vol.% Cu6Sn5 exhibited cleavage of the Cu6Sn5 particulate reinforcement and ductile, Mode I fracture of the eutectic matrix with no single origin of initiation corresponding to homogeneous ductile fracture.

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AN 127:84578 HCA
TI Issues regarding microstructural coarsening due to aging of eutectic **tin**-silver **solder**
AU Gibson, A.W.; Choi, S.L.; Subramanian, K.N.; Bieler, T.R.
CS Department of Materials Science and Mechanics, Michigan State University, East Lansing, MI, 48824-1226, USA
SO Des. Reliab. Solders Solder Interconnect., Proc. Symp. (1997), 97-103. Editor(s): Mahidhara, Rao K. Publisher: Minerals, Metals & Materials Society, Warrendale, Pa.
CODEN: 64QHAZ
DT Conference
LA English
AB Pending Federal regulations, environmental concerns, and alternate m.p.. **solders** provide the impetus for using Pb-free **solders**. Automotive electronics and **solders** are exposed to extreme thermal cycling at -40-+150.degree. under cyclic and quasi-static conditions [1]. and they experience low and high frequency mech. fatigue vibrations. Since coarsening of microstructural features is known to affect fatigue resistance, the aging behavior is studied using eutectic **Sn**-Ag **solder** as a model system, with and without 20 V% of a Cu6Sn5 **intermetallic composite** strengthening phase. The **composite solder** was developed to det. whether the microstructure could be stabilized to prevent coarsening. For comparative purposes, a **composite solder** was also made using eutectic **Sn**-Pb as the matrix. Small single shear lap specimens with a size similar to joints in microelectronic applications are used to obtain microstructures that result in real **solder** joints. Eutectic **Sn**-Ag **solder** joint microstructures coarsen when aged at +60-+150.degree. for as little as 100 h. The microstructural evolution is monitored with aging temp. and time, and the kinetics of aging is detd. The effects of adding **composite intermetallic** phases on the aging behavior are compared to the model **Sn**-Ag system. The effect of cyclic aging vs. static aging is studied in the **Sn**-Ag/Cu6Sn5 and **Sn**-Pb/Cu6Sn5 **composite solders**.

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Single shear lap joints of both solders were fabricated using copper substrates and subjected to isothermal mech., cantilever bending fatigue at a frequency of 50 Hz. The fracture surfaces of noncomposite eutectic Sn-Ag solder joints exhibited ductile, mixed mode (I and II) fracture behavior and step-type fatigue striations that originated at a local region. The fracture surfaces of the composite eutectic Sn-Ag solder contg. 20 vol.% Cu6Sn5 exhibited cleavage of the Cu6Sn5 particulate reinforcement and ductile, Mode I fracture of the eutectic matrix with no single origin of initiation corresponding to homogeneous ductile fracture.
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(1) Choi, S; Design & Reliability of Solders and Solder Interconnects 1997, P241
(2) Gibson, A; Design & Reliability of Solders and Solder Interconnections 1997, P97 HCA
(3) Gibson, A; IEEE International Symposium on Electronics & the Environment 1997, P246
(5) Mahidhara, R; Design & Reliability of Solders and Solder Interconnections 1997, P75 HCA
(6) McCormack, M; IEEE Transactions on Components Packaging and Manufacturing Technology-Part A 1994, V17(3), P452 HCA
ALL CITATIONS AVAILABLE IN THE RE FORMAT

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AN 127:84587 HCA
TI Mechanical properties of Sn-Ag **composite solder** joints containing copper-based **intermetallics**
AU Choi, S.L.; Gibson, A. W.; Mcdougall, J.L.; Bieler, T.R.; Subramanian, K.N.
CS Department of Materials Science and Mechanics, Michigan State University, East Lansing, MI, 48824-1226, USA
SO Des. Reliab. Solders Solder Interconnect., Proc. Symp. (1997), 241-245. Editor(s): Mahidhara, Rao K. Publisher: Minerals, Metals & Materials Society, Warrendale, Pa.
CODEN: 64QHAZ
DT Conference
LA English
AB Differential thermal expansion in electronic systems induce stresses resulting in substantial cyclic deformation of solder joints, which leads to eventual fracture. While fatigue deformation is a major concern for electronic solders, creep constitutes an important component of deformation since stress relaxation occurs after a temp. change. In realistic thermal cycles there is sufficient time for stress relaxation processes to occur, and creep induced damage may result. Small single shear lap joint specimens were made to simulate realistic solder joints. By aging these specimens at different temps., several variations in microstructure were obtained. In an effort to modify creep strength of a model Sn-Ag lead-free solder, copper based **intermetallics** were introduced into the solder. Solder joints were deformed in creep conditions at room temp., and after some steady state creep strain, load changes were made to facilitate the evaluation of the stress dependence of strain-rate and to reduce the no. of test specimens. Comparisons between unaged and aged specimens, and between non-composite and **composite solders**, were performed. The anal. of fracture surface of crept solder joints was performed with SEM.